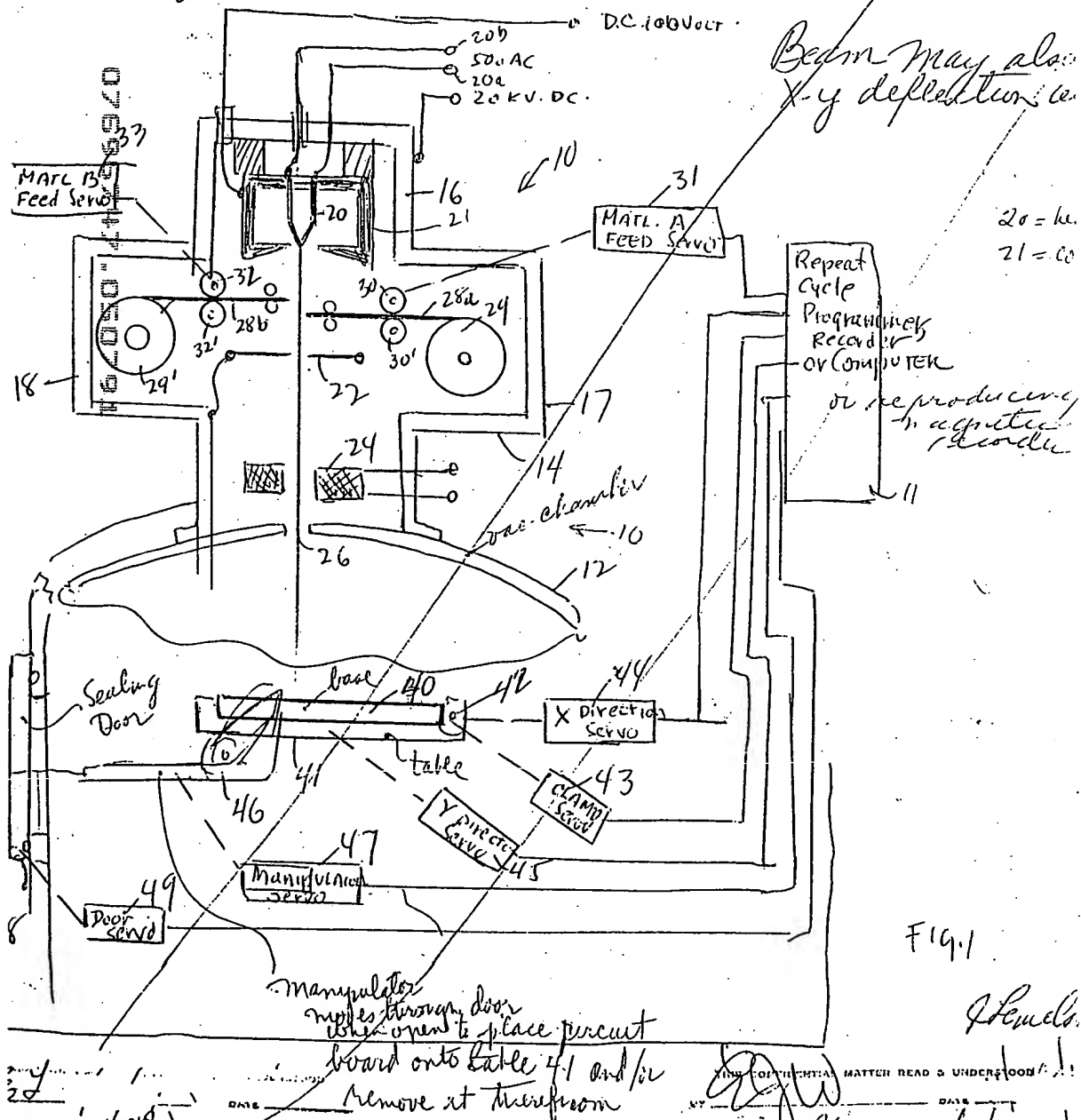


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with and recording machine;
(a)

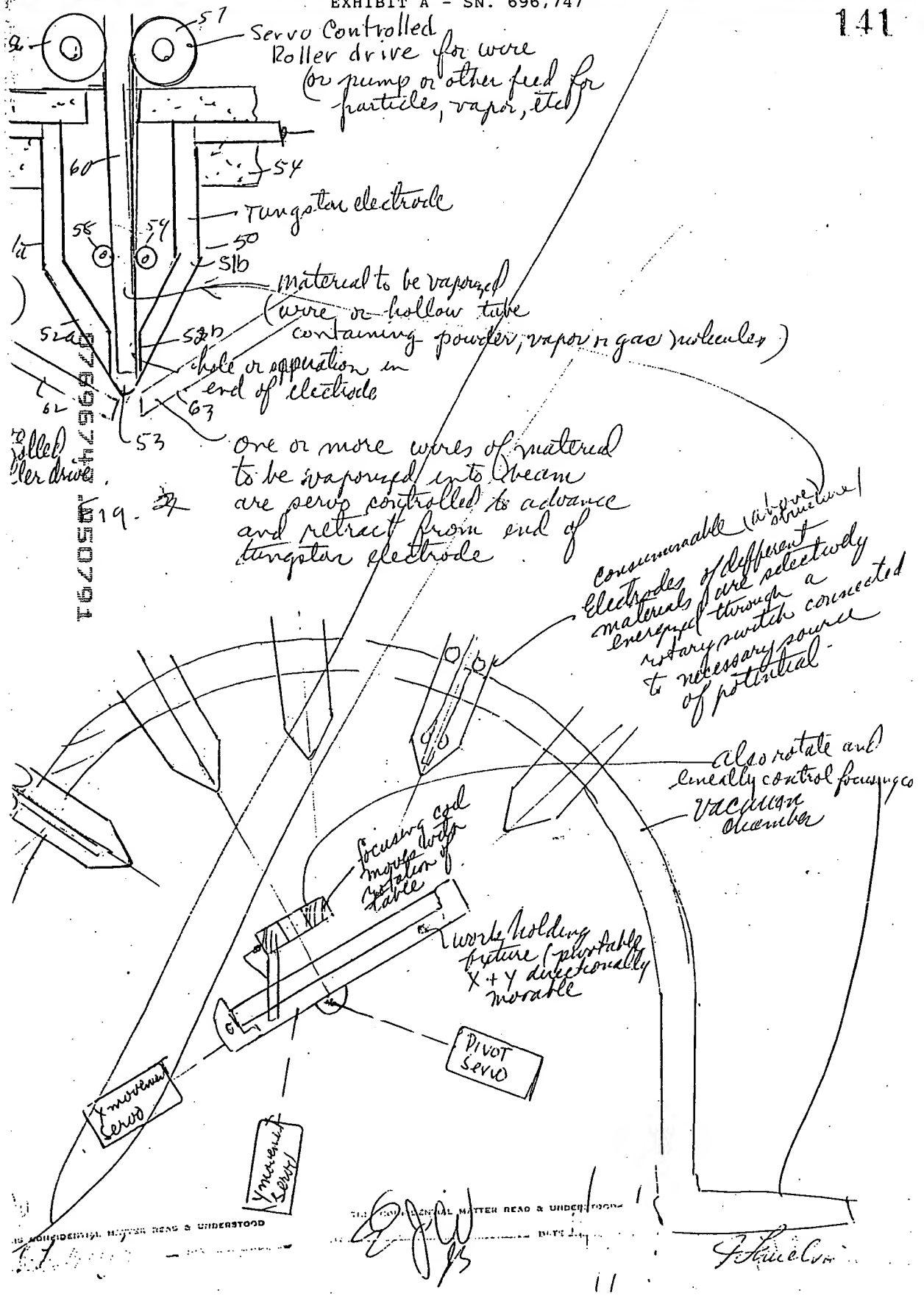
Electron Beam Deposition of Circuits

The following arrangements have been conceived for depositing electronic circuits onto bases.



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In the electron beam apparatus of pp 140 & 141 the claims for which I have been working on over the past 10 months it is noted that:

(1) The beam may be deflection controlled by means of an analog signal or signals using deflection plates of conventional design

(2) ~~The beam focus~~

All servos such as door ~~to~~ vac. chamber opening & closing servo, work positioning servo, ~~and~~ servos for feeding material into the beam manipulator for admitting and removing work from chamber, work clamping servo, etc. as well as the means for controlling focus, deflection, and selection of (one of a multiple of) beam may be automatically controlled in an automatic cycle of operations by means of a programming means such as a magnetic or other recorder on which is recorded the necessary analog and/or digital signals to effect such control which record is operated and transduced from to derive vac. signals in a predetermined sequence.

(3) Material to be deposited may be admitted to beam as a rod or wire, powder, liquid, or gas which materials are carried along in beam to work piece and focused thereon by beam energy or modulation may be controlled by a reproduced analog or digital signals to prepare (heat or erode, melt or vaporize) surface on which selected deposits are to be made.

(4) Chemical reactions, alloying, doping, etc may take place in beam or by means of beam and material therein deposited on or diffused into surface intersected by beam.

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machining or otherwise physically
chemically changing material deposited
can may be effected by change of
beam energy, etc or by means of
more auxiliary beams generated
in same gun or chamber (different guns)
are similarly deflection controlled and
fed

material to be deposited (wire, powder, vapor,
gas) may be positionally controlled by
or servo controlled by the programming
controlling the other variable to be
followed or moved into the volume
focus of the beam directly above surface

may be focused in gun into which
material is selectively fed and controlled
by programming means. After focus beam
be diverged or directed as a narrow
against surface of work and/or deflectionally

auxiliary beam may feed into main beam
after or at its focus or near its generation
which auxiliary beams contain atoms of
material to be deposited onto surface by
beam. Which may be deflection controlled
for in accordance with a programmed

optical maser may be used as an
energy beam generator in conjunction with
arrangements or in place of electron
generating means thereof. Maser beam
be travelled inside or parallel to electron beam
axis, or may be directed at the focus
electron beam to cooperate in machining,
otherwise affecting surface of work or evaporating
material to be fed to beam.

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General

Beam Deposition Continued

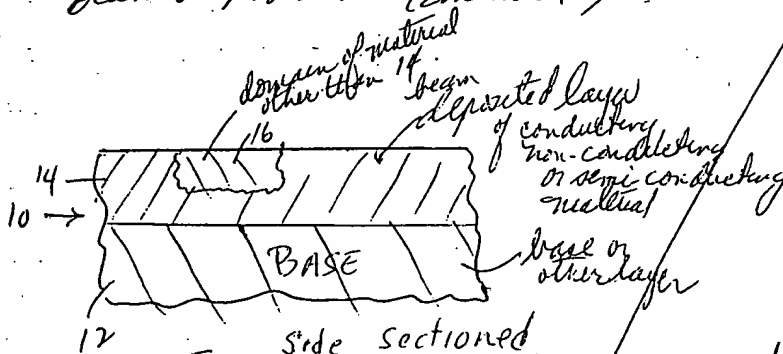
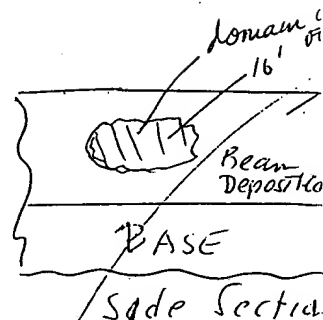
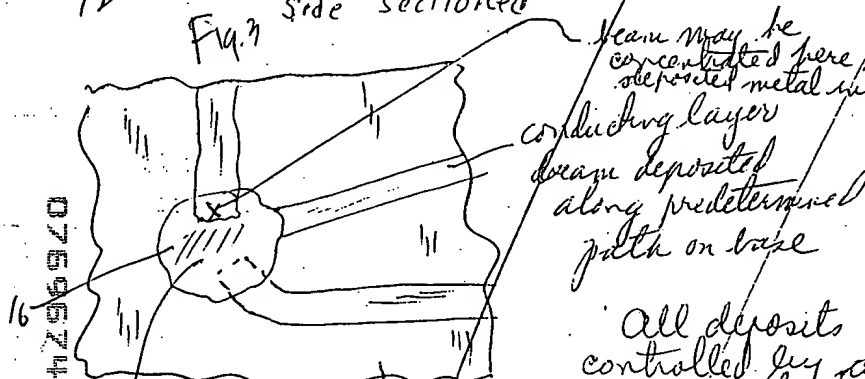


Fig. 7 Side sectioned



Side Section



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domain or surface deposits of semi-conducting device material admission to beam or electrode controlled by computer or programming means

All deposits are by beam controlled by analog signals reproduced from a recorder which records programmed signals (reproduction) also control material selection (mt into beam, rate of flow there travel of beam across work and on/off of beam position workpiece, handling of work within and in and out of vacuum chamber, etc.)

Feedback signals for indicating how much material is deposited and where to control beam position, flow and selection of different materials to be admitted to beam may be effected by means a reading electron beam directed by computer or programmed (recorded signals) to scan selected area or scanning entire target as the material is deposited or during periods when material

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* heavy deposited (inspection scanning period). The
 out video signal derived by beam scanning
 y be analyzed by techniques as described in
 pending application "Automatic Inspection System"
 digitally determining in digital form the
 characteristics (optical characteristics) of the material
 deposited.

Spectroscopy may also be employed in
 which a beam is directed against the deposited
 a and causes an emission of electrons therefrom
 which is spectrally analyzed; the results of
 which are used to control further deposition
 removal of deposited material.

Ernest Waldmeyer
 11/11/11

Material from p. 138
 to this point read by
 Indore Math on

Classification of Electron Beam Deposition apparatus & Methods.

The following are arrangements, apparatus and methods
 concerned relating to electron beam manufacture of micro-
 circuit circuits which I intend to incorporate in a number of
 applications.

Deflection and intensity control of deposition (or machining, welding,
 electron beam or beams attained by one of the following techniques:

- (a) Reproduced magnetically recorded video picture signal or signals.
- (b) video signal generated by scanning optical recording
- (c) output of digital recorder
- (d) output of comparator (summing amplifier) fed (a) or (b) above
 plus feedback signal generated by scanning either or both
 beam containing deposition material or surface containing
 deposited material.

Correction for over or incorrect area deposition may be made
 controlling beam per-sec (by computer command signals or
 input of summing amplifier being fed command reproduced video
 signal and feedback scanning signal) which beam either

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machines or vapours material already deposited. **
 ** Vaporized material (vaporized by corrective beam) may be
 removed from surface of workpiece by another beam of
 deflection controlled or otherwise positioned to effect said
 removal.

Correction for over deposition may also be made - deflection controlled beam containing an oxidizing or other - for chemically changing part of deposited material to an compound.

Work may be positionally controlled by command signals derived from command recording as described or complex receiving command and feedback signals as described.

Deflection control of beam (x, y. position plus intensity modulation) plus position of focus (z control) depending on position of the surface being scan-deposited on.

(a) Depositing semi-conductors with

- (a) depositing semi-conductor, metal or dielectric materials
- (b) depositing plural materials simultaneously
- (c) " " " at different times by different single beam.
- (d) introducing different material at same or different time
- (e) welding, machining, vaporizing deposited material

III Feedback signal compared with reference command (represented by $e(t)$) is generated by:

- (a) Beam scanning and analysis of ionized or vapourized parts therein as beam is generated and material(s) admitted there
(b) Optical beam or work scan plus analysis
(c) Spectroscopy or spectrographic (automatic) analysis - mass spectrograph + scan
(d) Electron beam scan of deposited work with a video read beam

IV Material Feed (to beam) by and as:-

- (b) Rod or wire, servo driven into beam, into ^{intermediary} beam focus, the electrode generating beam (into orbit between electrodes) or directly into output receiving reproduced command signal plus feedback signal.
- (c) Servo controlled powder feed (as above)
- (d) Servo valve controlled (as above) feed of liquid conta

ation material into beam (or vaporized deposition material into beam).

Plural Beams

Plural reproduced deflection control signals plus trial control or reference signals, plus work positioning also (optional), plus focus adjustment signals (optional) other mentioned above are used to simultaneously, quickly control beams each depositing different material alternately.

Beam Deposition Techniques (Miscellaneous features)

(a) Electron beam plus photographic techniques

(1) Beam deposits components onto conducting film pattern formed by photo-etching, photo composition (exposure to light and developing)

(2) Optical beam (laser light beam) is deflection controlled and cooperates with deflection controlled electron beam in welding, machining, effecting deposition, chemically reacting on deposited materials, deposited by electron beam, etc. Laser light beam may also be used to carve photoconductor film, expose it per se, develop image, used for correct type purposes (vaporize or machine material/film) deposited by electron beam, vaporize material(s) to be deposited or directed by electron beam, etc. work, etc. Laser beam deflection controlled by servo controlled mirror(s) controlled by reproduced command signal or output of comparator or computer.

(b) Plural beams cooperate. One vaporizes (laser or electron beam) material to be deposited; feeds it at or to second deposition beam, which is deflection controlled and deposits material, and beam scans either second beam or surface which has just received material to provide a feedback signal a comparator (summing amplifier or other) which provides an output to control both first and second beams (i.e. on-off or intensity or focus of first beam and position of second beam) (first and second beams controlled by respective command signals fed to

respective comparator means each of which receives same feedback signal generated by third beam scanning what is being or was just deposited

(c) An apparatus for repairing, modifying or adding micro-miniature circuits has also been conceived based on beam scanning the circuit already deposited (surface scanning) and determining by reading with the beam the physical-optical or atomic structure of the circuit, by x-ray scanning, by optical scanning said circuit (with a modulated light beam) or by a combination of two or three of these scanning techniques, the output signal derived by scanning is fed to a computer which thereafter provides signals for controlling beam deflection, modulation, position of workpiece, material selection and feed to beam, mask selection, etc. to effect a desired repair, change in structure, etc.

(d) Vaporization of material in a primary electron beam by means of a mask through which beam of the deposited beam is passed and picks up the material to be deposited, carrier.

(e) Material changed by, new composition(s) formed in a beam directed against a workpiece by either the action of the beams per se or the reaction of the beam (temperature, and two or more of the materials admitted thereto or one or more admitted material and material of the workpiece.

(f) Growth of predetermined crystal structure by means of beam melting material(s) admitted thereto and deposited, or by a combination of materials admitted to beam being deposited thereby onto a crystal being grown. Programmed control of beam deflection, on-off modulation, focus, crystal movement, material flow into beam (based on feedback derived by scanning beam, crystal, etc. (as described above) fed into comparator also command signal and providing difference signal for control.

(g) Creation of mask through which erosion electron beam is directed for chemically or mechanically affecting or changing chemically, welding, etc. the workpiece by means of photosensitive mask material, thermoplastic recording film of General Electric Co. which mask is formed by exposure to a writing beam of said mask material which writing beam is modulated to affect the desired image (transparent and opaque or vice versa) pattern in the mask. Mask may be in the field of the

ited against the workpiece (in path of beam)

(b) Use of a unique mask in beam path made of a grating - as a diffraction grating produced by beam etching thin plate selective and controlled deposition of material introduced into beam or to or after passing thru mask. Plural diffraction gratings used at right angles to each other will produce line beams less than .001 inches in diameter.

(c) Use of a mask to break up beam intense electron or maser beam into a plurality of beams directed thereafter against selected areas of the workpiece for effecting welding, machining (hole drilling), erosion or deposition onto said selected areas.

(d) Program control (plus feedback where necessary) of beam turn (deflection), focus, etc. & position of workpiece, and different material fed into beam to selectively deposit different material onto different areas of workpiece.

(e) Exposure, machining, chemically changing, development and use of a photosensitive material to form a circuit by means of a beam and use of beam to deposit semi-conducting, dielectric or insulating materials onto selected areas of photosensitively developed circuit all by automatic control as above.

J. L. Miller

C. L. Miller

PAGE 150 - IS MISSING

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Extrude multiple sheets or strips apart & filaments
(of different materials) + laminate continuously.

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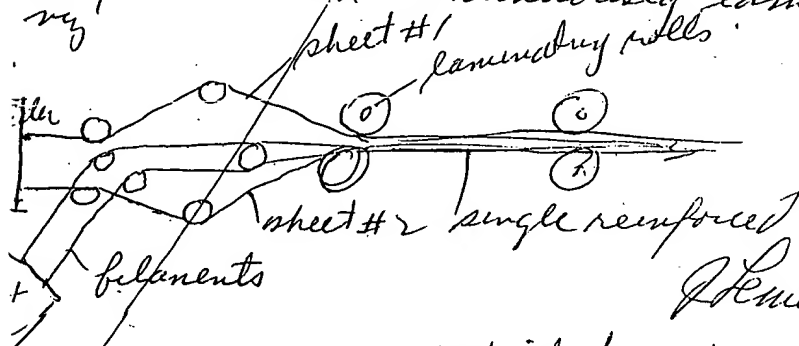
to rods, tubes, wires or other structural members made of
plastic filaments or metal whiskers (single crystals
of metal of exceptional strength) which are compacted
together and bonded or welded where they cross.
They may be encapsulated in another plastic, metal,
sandwiched powdered metal, etc to form solid, filament
reinforced structures.

It is conceived to simultaneously extrude a plurality
of sheets of thermoplastic or ribbons thereof from a single
die but from spaced-apart slit openings and guide
said sheets or strips as follows:

(a) First guide apart ^{continuously} filament (reinforcing
or decorative), or cloth, threads or other material as a
continuous or broken web between two of said strips and
continuously laminate into a single, integral sheet
of reinforced material.

(b) Drive each sheet thru polishing rolls and
then laminate (improved clarity).

(c) Simultaneously extrude from another extrusion
hammer, a plurality of reinforcing filaments (of glass,
polypropylene, or other plastic), guide these between
at least two of the strips, or ribbons or sheets
not extruded and continuously laminate together.



Material from p 145 to this point
read + understood by me this 4th
day of September